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Ultimately Dr. Chandler's formula, or a slight modification of it, may be proved correct, and with it we may be able to state what the latitude of any place will be at any time.

The lecture was followed by some illustrations showing that revolving bodies preferred to revolve about their shortest axis or around the axis about which the moment of inertia was a maximum.

Charts and diagrams were exhibited showing the results of observations made at Pulkova, Prague, Berlin, Strassburg, Bethlehem and the Sandwich Islands, etc.

These results were compared with the deductions from Chandler's formula and shown to agree therewith to a remarkable extent.

The preliminary results of the observations made at Columbia College from May, '93, to July, '94, were exhibited.

The lecturer threw on the screen illustrations of several forms of Zenith Telescopes and described the new form made by Wanschaff, of Berlin.

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CURRENT NOTES ON PHYSIOGRAPHY (VII).

AREA OF LAND AND WATER.

PROFESSOR H. WAGNER, of Göttingen, contributes to the April number of the *Scottish Geographical Magazine* an abstract of his recent studies on the land and water areas of the globe for successive latitude belts. He contends that Murray's figures, published in the same magazine for 1886 and 1888 and based on Bartholemew's maps, are inaccurate to a significant extent. Wagner's measures of the better known lands between 80° north and 60° south latitude is 51,147,100, against Murray's 51,298,400 square miles. Taking 250,000 for lands yet undiscovered in the Arctic regions, and 3,500,000 for Antarctic lands, the total

land area of the globe would be 55,814,000 square miles. Wagner finds confirmation of his figures in the results independently obtained by K. Karstens, who has recently made a new reckoning of the area and mean depth of the oceans.

THE 'FLY-BELT' IN AFRICA.

THE remarkable control over the occupation of Africa, exercised by the little tse-tse fly, whose bite is fatal to horses and cattle, leads to the introduction of cheaply constructed narrow-gauge railways across the belt of country dominated by this pest. The Portuguese district, next south of the Zambesi river on the east coast, with its capital at the little settlement of Beira, attains some commercial importance from its relation to Mashonaland and the gold district of the interior; but in order to connect the two, a railway a hundred and twenty miles long has been made 'to bridge the fly-belt.' The coast exhibits a combination of equatorial and tropical rainfall, having high temperature and heavy rain from October to April, but from June to September 'the weather is almost pleasant.' At Beira the scarcity of water in the dry season threatened a few years ago to be a serious question, as a supply had to be brought from the upper course of the rivers at a considerable cost; but "in 1893 a Scotch plumber was imported, and all anxiety on this score came to an end," as he made galvanized iron tanks in which rain water could be gathered and stored from the roofs (*Scot. Geogr. Mag.*, April, '95).

COLD AND SNOWFALL IN ARABIA.

THE ordinary association of heat with the dryness of deserts tends to give the impression that Arabia has no cold weather. Nolde's account of his expedition into the Nefud desert of the Arabian interior, latitude 28 north, altitude 3,000 feet, tells of the severe cold that he experienced there in

February, 1893. The days were warm and pleasant; but the nights cooled to -5° or -10° C; the changes of temperature being extremely sudden. For example, on February 1, at noon, the thermometer read $+5^{\circ}.5$, with a cool wind; at 2 o'clock, $+6^{\circ}$, at 4, 7.5° ; then came a rapid rise to 25.5° , for which no special explanation is given. Just after sunset there was a sudden fall of thirty-three degrees, to -8° ; and the minimum of the night was -11° . The cold and blustering wind caused much discomfort in traveling. The greatest surprise that Nolde met was on February 2, when a storm clothed the Nefud far and wide with a sheet of snow several inches deep, making it resemble a Russian steppe rather than an Arabian desert. The Bedouins, however, said that snowfall there was very unusual. (*Globus*, 1895, No. 11.)

CENTRAL AMERICAN RAINFALL.

PROF. M. W. HARRINGTON shows in an article under the above title (*Bull. Phil. Soc. Washington*, xiii., 1895, 1-30) that the northeast slope of Guatemala and Honduras has rainfall maxima in June and October, following the zenithal passages of the sun and a moderate winter maximum in January, ascribed to the encroachment even in these low latitudes of cyclonic areas from the westerly winds of the temperate zone. This gives an interesting repetition of the case of northern India, as described by Blanford. The rainfall on the southwest slope of Central America has maxima in June and September-October, corresponding to the two zenithal passages of the sun. The July-August minimum is faintly marked, while that of January and February is very low and for a time almost rainless. It is noteworthy that the zenithal rains here are often accompanied by strong squally winds from the southwest, suspected of being occasional extensions of the southeast trade wind across the equator into our

hemisphere. It may be remarked that the association of these winds with the counter current that runs eastward in the Pacific a little north of the equator confirms the suggestion that the equatorial counter currents in general are caused by the extension of the trade winds of one hemisphere across the equator into the other hemisphere. They are thus deflected from a westward to an eastward course, and hence locally produce eastward currents.

THE METEOROLOGISCHE ZEITSCHRIFT.

THE thoroughness so characteristic of German scientific work appears in this excellent journal, the leader of its class, with its able original articles, its rich variety of notes and its exhaustive bibliographic reviews. Originally established thirty years ago by the Austrian Meteorological Society, and edited successively by Jelinek and Hann, of Vienna, it was enlarged eleven years ago by further assistance from the German Meteorological Society, when Köppen, of the naval observatory at Hamburg, became associate editor; his place being lately taken by Hellman of the Prussian Meteorological Institute at Berlin. Dr. Hann, however, still retains his position as leading editor and is a frequent contributor to the pages of the journal. One of his latest essays (January, 1895) is on the rainfall of the Hawaiian Islands, in which he brings together all available material, and discusses it more completely than has hitherto been done. Dutton's explanation of the considerable rainfall on the southwest slope of Hawaii is quoted with acceptance. A meteorological peculiarity of these islands seems to be that their richer windward sides, sloping to the northeast with a plentiful rainfall, are on a large part of the coast with difficulty approached from the sea on account of the cliffs that have been cut along the shore by the strong surf from waves driven by the trade winds.

FOEHN-LIKE EAST WINDS IN AFRICA.

DANCKELMAN, who for some years has made a special study of African meteorology, contributes a note on the foehn-like east winds felt on the southwest coast of Africa, about the southern tropic (*Met. Zeitschr.*, January, 1895). In the interior, temperatures above 27°C are unknown in the winter (April to October); but on the coast in this season, maxima over 30°, and even as high as 39°, are reported, east winds and low humidity occurring at the same time. As so high a temperature cannot be ascribed to heat from the interior, Danckelman explains it as the result of the dynamic warming of the wind during its descent from the interior highlands. This is only one more illustration of the importance of adiabatic changes of temperature in meteorological phenomena; the Swiss foehn and our western chinook, the extraordinary foehn-like winds of west Greenland, the 'hot winds' of India and of Kansas, as well as the ordinary warm or hot southerly cyclonic winds, or 'siroccos,' all owing a greater or less share of their high temperatures to the heat developed by compression during the descent of air from higher to lower levels.

THE AMERICAN METEOROLOGICAL JOURNAL.

THE American Meteorological Journal, conducted for a number of years by Professor Harrington at Ann Arbor, and since 1892 edited by R. DeC. Ward and published by Ginn & Co., Boston, is an able exponent of the science of the atmosphere for this country. The closing number (April, 1895) of the eleventh volume opens with a note by the editor, reviewing the recent work of the journal, and making an excellent showing for its continuation. Its original articles make it of value to the investigator; its notes and reviews place much important material before the general student; and its more elementary or educational articles

must prove useful to the teacher, for in spite of a recent assertion to the effect that the meteorological aspects of geography are well taught in our schools, there is room for much improvement in this direction. The April number contains notes on signs of a recent change of popular opinion concerning the effect of cultivation on rainfall in Iowa, the proceedings of the last meeting of the New England Meteorological Society—the only society of the kind, we believe, in this country—and diagrams of a curiously curved storm track from the Pilot chart of the Hydrographic office; reviews of the Blue Hill (Mass.) observations for 1893, of Ley's new work on clouds, and of a new Danish series of monthly pressure charts for the North Atlantic. The editor contributes an account of Swiss studies of thunderstorms, and a description of meteorological work in India and Australia. The wind known as the 'southerly burster,' as felt at Sydney, has recently been studied in a prize essay; it recalls in many particulars the 'northers' of our Texan coast.

NOTE ON CROLL'S GLACIAL THEORY.

A BRIEF article by the undersigned (reprinted in *Amer. Met. Journal* for April from the *Trans. Edinb. Geol. Soc.*, vii., 1894, 77–80) suggests a common explanation for three forms of geologically recent climatic change, namely, the glaciation of many northern lands, the expansion of many interior lakes, and the production of *wadies* by water action in the now dry Sahara. Accepting Croll's theory of the coincidence of glacial conditions with long aphelion winters during periods of great orbital eccentricity, it is argued that the chief cause of snowy precipitation at such times must be the greater activity of cyclonic processes, then intensified by the stronger general circumpolar circulation, in turn accelerated by the increased winter contrast of polar and equatorial temperatures;

Hann's dynamical theory, instead of Ferrel's convectional theory of extra-tropical cyclones, being adopted. All those regions whose precipitation is in large part dependent on extra-tropical cyclonic storms would under these conditions have an increased annual rainfall; and the lakes of interior basins in temperate latitudes would consequently increase in volume. The winter rains of subtropical belts, such as the northern Sahara, would extend further towards the equator, for the equatorward migration of the tropical belt of high pressure in winter is essentially a result of the increased vigor of the circumpolar circulation at such times; thus the formerly greater rainfall indicated by the desert *wadies* might be explained. The coincidence of greater precipitation during the same epochs of time over the glaciated, the lacustrine and the desert areas is, however, not yet independently proved.

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GRAVITY MEASUREMENTS.*

RELATIVE measurements of the force of gravity were made in 1894 by the U. S. Coast and Geodetic Survey at twenty-six stations, mostly located along the thirty-ninth parallel from the Atlantic coast to Utah. Points were included on the Atlantic coast, Appalachian mountains, central plains, Rocky mountains (including the summit of Pike's Peak, 14,085 feet in altitude), western plateaus, and the eroded valleys of the Green and Grand rivers.

* 'Results of a Transcontinental Series of Gravity Measurements,' by G. R. Putman, read February 2, 1895, Philosophical Society of Washington, Bulletin Vol. xiii.; preliminary results were presented before the National Academy of Sciences by Dr. Mendenhall, November, 1894. Mr. G. K. Gilbert, of the U. S. Geological Survey coöperated in this work by making a geological examination of the stations. His conclusions and a discussion of the results in connection with the theory of isostasy are published in the same Bulletin.

The half second pendulum apparatus designed by Dr. T. C. Mendenhall was used, with methods not before employed with short pendulums. They were swung at a low air pressure (60 mm.), each swing lasting eight hours, and the successive swings covering the entire interval between the first and last time observations, usually forty-eight hours. The two chronometers used were rated by star observations made with a portable transit in the meridian. The flexure of the support was measured and correction applied. The results indicate the entire elimination of errors due to diurnal irregularities of rate, and show that there was practically no wear of the agate knife-edge. Determinations made at the base station (Washington) several times during the year show a range of only .000,004 second in the mean period of the three pendulums, indicating a high permanency of period, and throwing some light on the invariability of gravity. The average time required per station was slightly over five days.

Values of gravity for Washington derived relatively from absolute determinations made in various parts of the world show a considerable discordance, the range being from 980.047 to 980.285 dynes. The results of the past season are based on a provisional value adopted for Washington. As they were carried out with the same instruments and uniform methods, it is probable that their relative accuracy is much higher than that of many of the absolute measures.

The results are discussed principally in connection with the question of reduction to sea level, the distribution of the stations with respect to an unusual variety of continental conditions rendering the series valuable in this connection. This is an important question in the application of pendulum observations to the geodetic problem of the earth's figure, and involves the various theories as to the condition of the